

**OFFICE OF WATER QUALITY
INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
ASSESSMENT BRANCH
Environmental Toxicology and Chemistry Section**

INFORMATIONAL PAGE

IDEM Document Control Number: IDEM/100/29/404/04/2001

Date: April 16, 2001

Title: Water Quality Assessment for the Development of Total Maximum Daily Loads for *E. coli* and Cyanide in Trail Creek, Michigan City, LaPorte County

Sample Matrix: Water (X); Sediment (); Fish Tissue ()

Location: Lake Michigan Basin

Hydrologic Unit Code: 04040001070

Author and Title: Cynthia Parrett Wagner, Senior Environmental Manager,
TMDL Program Manager

Abstract or Summary: Trail Creek is on the 1998 303(d) List for *E. coli* and Cyanide. Sampling in the summer of 2000 verified the *E. coli* impairment and showed the water quality standard for cyanide being met.

Keywords: Trail Creek, *E. coli*, Cyanide, 303(d) List, Impaired Waterbody



IDEM/100/29/404/04/2001

**Water Quality Assessment for the Development
of Total Maximum Daily Loads for
Escherichia coli (*E. coli*) and Cyanide in
Trail Creek, Michigan City, LaPorte County**

**By: Cynthia Parrett Wagner
TMDL Program Manager
Environmental Toxicology and Chemistry Section
Assessment Branch, Office of Water Quality
(317) 308-3214
cwagner@dem.state.in.us**

**Indiana Department of Environmental Management
100 N. Senate Avenue
P.O. Box 6015
Indianapolis, IN 46206-6015
IDEM/100/29/404
Date: April 2001**

CONTENTS

INTRODUCTION.....	1
METHODS	1
A. Sampling Sites and Locations.....	2
B. Sample Collection.....	2
C. Protocol Deviations.....	2
RESULTS	2
A. Applicable Water Quality Standards.....	2
B. E. coli.....	2
C. Cyanide.....	4
D. Field Measurements and General Chemistry.....	4
DISCUSSION	6
RECOMMENDATIONS.....	6
TABLES AND FIGURES	
Table 1: E. coli Results.....	3
Table 2: Cyanide Results.....	4
Table 3: General Chemistry Results.....	4
Table 4: Field Measurement Data.....	5
Table 5: Stream Flow.....	6
Figure 1: Map of Sampling Sites.....	7
ATTACHMENTS (NOTE:THE ATTACHMENTS LISTED BELOW ARE AVAILABLE UPON REQUEST FROM THE AUTHOR OF THIS REPORT)	
A. 2000 Sampling and Analysis Workplan For Trail Creek	
B. Fixed Station Data	
C. QA/QC Review Reports	
i. IDEM 100/29/477/022/2000: E. coli 08/09/2000	
ii. IDEM 100/29/477/029/2000: E. coli 08/16/2000	
iii. IDEM 100/29/477/044/2000: E. coli 08/23/2000	
iv. IDEM 100/29/477/35/2000: E. coli 08/30/2000	
v. IDEM 100/29/477/37/2000: E. coli 09/06/2000	
vi. IDEM 100/29/477/024/2000: Cyanide 08/09/2000	
vii. IDEM 100/29/477/033/2000: Cyanide 08/23/2000	
viii. IDEM 100/29/477/064/2000: Cyanide 09/06/2000	
ix. IDEM 100/29/477/098/2000: General Chemistry Data 08/23/2000	

INTRODUCTION

The Trail Creek Watershed is located in northern Indiana in LaPorte County, Hydrologic Unit 04040001070. Trail Creek is designated as a Salmonid stream and shall be protected for supporting a salmonid fishery pursuant to Title 327 of the Indiana Administrative Code 2-1.5-6. The creek flows into Lake Michigan and has a drainage area of 59.1 square miles. It is contained almost completely in LaPorte County except for two first order streams extending into Michigan. The United States Geological Survey (USGS) Gaging Station on Trail Creek, active since October of 1994, is located at river mile 0.5 at the Franklin Street drawbridge in Michigan City. Trail Creek has a 7Q₁₀ low-flow of 24 cubic feet per second (cfs).

The Northwest Indiana Inter-Agency Technical Task Force on *E. coli* has been meeting since February 14, 1996 to address the widespread fecal bacteria problem in the region's recreational surface waters. The Task Force has twenty-three sampling sites or proposed sampling sites in the Trail Creek Watershed.

Section 303(d) of the Clean Water Act requires states to develop lists of waters needing Total Maximum Daily Loads (TMDL), and to establish priorities for TMDL development according to the severity of the pollution and the uses to be made of the waters. The IDEM Assessment Branch Fixed Station Monitoring Program indicated unacceptable levels of *E. coli* bacteria and possibly cyanide in Trail Creek. The *E. coli* impairment was identified as a water quality problem and included on the Office of Water Management's 1996 303(d) list of impaired waterbodies. Trail Creek is also on the 1998 303(d) list for Cyanide.

METHODS

A. Sampling Sites and Locations

The initial water quality assessment survey consisted of nine sites, seven on Trail Creek, and two sites on tributaries.

Site #	Stream Name Latitude Longitude	Location
LMG070-0012	Trail Creek N 41° 43' 22.01", W 86° 54' 15.98"	Fixed Station TC .5, Franklin St. Bridge on US 421 Active USGS Gage
LMG070-0013	Trail Creek N 41° 43' 18.01", W 86° 53' 48.98"	Fixed Station TC 1, US Highway 12 Bridge
LMG070-0014	Trail Creek N 41° 43' 7.34", W 86° 53' 1.94"	Michigan City WWTP Effluent

LMG070-0015	Trail Creek N 41° 43' 21.00", W 86° 52' 32.99"	Fixed Station TC 2, Liberty Trail Bridge
LMG070-0016	Trail Creek N 41° 43' 0.36", W 86° 51' 35.97"	Springland Avenue (Old USGS Gaging Station)
LMG070-0017	Trail Creek N 41° 42' 19.48", W 86° 51' 22.65"	US 35
LMG070-0018	Trail Creek N 41° 41' 14.89", W 86° 50' 41.24"	US 20
LMG070-0019	W. Branch of Trail Cr. N 41° 41' 9.53", W 86° 50' 40.19"	Bleck Road
LMG070-0020	E. Branch of Trail Cr. N 41° 41' 28.68", W 86° 48' 58.18"	C.R. 600 W.

B. Sample Collection

Trail Creek was sampled five times at equally spaced intervals within a thirty day period from August 6 through September 6, 2000 so that a geometric mean for *E. coli* could be calculated. Water samples for free cyanide measurements were also collected during three of the five individual samplings for *E. coli*, on August 9, 23 and September 6. The *E. coli* and Cyanide samples were taken to Environmental Health Laboratories (EHL) in South Bend to meet the 6 hour holding time for the *E. coli* samples.

C. Protocol Deviations

The sampling activities were carried out as described in the 2000 Sampling and Analysis Workplan for Trail Creek.

RESULTS

A. Applicable Water Quality Standards

For recreational uses, the Water Quality Standard (WQS) for *E. coli* bacteria shall not exceed 125 coliform forming units (cfu) per 100 ml of sample as a geometric mean based on 5 samples evenly spaced over a 30 day period, nor a single sample exceed 235 cfu per 100 ml. The WQS for recreational uses applies from April 1 through October 31. For cyanide, the Great Lakes Basin WQS is for free cyanide not to exceed 5.2 µg/l.

B. *E. coli* (Table 1)

All sites on Trail Creek except the Michigan City Sanitary District effluent violated the geometric mean of 125 cfu per 100 ml of sample. The values ranged from 138 to 922 cfu/100 ml. The Michigan City Sanitary District effluent was also in compliance with the single sample maximum standard of 235 cfu. The highest single measurement of 3100 cfu/100ml occurred at the site on the West Branch of Trail Creek at Bleck Road on August 23.

TABLE 1
***E. coli* cfu/100 ml Concentrations in Trail Creek and its Tributaries**
August –September, 2000

Site Name	Surface Water Name	Sample No.	Date Sampled	Lab Results	Geometric Mean	WQS Violation
LMG070-0012	Trail Creek	AA00811	8/09/00	360	176	yes
		AA01579	8/16/00	90		no
		AA01681	8/23/00	30		no
		AA01778	8/30/00	380		yes
		AA01830	9/06/00	20		no
LMG070-0013	Trail Creek	AA00812	8/09/00	360	138	yes
		AA01580	8/16/00	80		no
		AA01683	8/23/00	120		no
		AA01780	8/30/00	90		no
		AA01832	9/06/00	40		no
LMG070-0014	Trail Creek	AA00813	8/09/00	10	10	no
		AA01581	8/16/00	10		no
		AA01684	8/23/00	10		no
		AA01782	8/30/00	10		no
		AA01835	9/06/00	10		no
LMG070-0015	Trail Creek	AA00814	8/09/00	610	460	yes
		AA01577	8/16/00	290		yes
		AA01685	8/23/00	560		yes
		AA01781	8/30/00	520		yes
		AA01833	9/06/00	320		yes
LMG070-0016	Trail Creek	AA00815	8/09/00	330	322	yes
		AA01582	8/16/00	410		yes
		AA01686	8/23/00	320		yes
		AA01783	8/30/00	420		yes
		AA01836	9/06/00	130		no
LMG070-0017	Trail Creek	AA00816	8/09/00	420	300	yes
		AA01583	8/16/00	370		yes
		AA01687	8/23/00	170		no
		AA01784	8/30/00	30		no

		AA01837	9/06/00	510		yes
LMG070-0018	Trail Creek	AA00817	8/09/00	180	586	yes
		AA01584	8/16/00	280		yes
		AA01688	8/23/00	2000		yes
		AA01786	8/30/00	360		yes
		AA01839	9/06/00	110		no
LMG070-0019	W.B. Trail Creek	AA00818	8/09/00	500	922	yes
		AA01585	8/16/00	30		no
		AA01689	8/23/00	3100		yes
		AA01785	8/30/00	470		yes
		AA01838	9/06/00	510		yes
LMG070-0020	E.B. Trail Creek	AA00820	8/09/00	360	498	yes
		AA00820	8/16/00	720		yes
		AA01690	8/23/00	450		yes
		AA01787	8/30/00	460		yes
		AA01840	9/06/00	500		yes

C. Cyanide (Table 2)

All free cyanide values were below the WQS.

TABLE 2
Free Cyanide Results (ug/l) for Trail Creek and Its Tributaries
August -September, 2000

Site Name	Surface Water Name	Sample No.	Date Sampled	Free Cyanide
LMG070-0012	Trail Creek	AA00811	8/9/00	1
		AA01681	8/23/00	1
		AA01830	9/6/00	4
LMG070-0013	Trail Creek	AA00812	8/9/00	2
		AA01683	8/23/00	2
		AA01832	9/6/00	3
LMG070-0014	Trail Creek	AA00813	8/9/00	1
		AA01684	8/23/00	2
		AA01835	9/6/00	4
LMG070-0015	Trail Creek	AA00814	8/9/00	0
		AA01685	8/23/00	1
		AA01833	9/6/00	3
LMG070-0016	Trail Creek	AA00815	8/9/00	1
		AA01686	8/23/00	1
		AA01836	9/6/00	3
LMG070-0017	Trail Creek	AA00816	8/9/00	0
		AA01687	8/23/00	0
		AA01837	9/6/00	3

LMG070-0018	Trail Creek	AA00817	8/9/00	2
		AA01688	8/23/00	0
		AA01839	9/6/00	5
LMG070-0019	W.B.Trail Creek	AA00818	8/9/00	2
		AA01689	8/23/00	0
		AA01838	9/6/00	0
LMG070-0020	E.B. Trail Creek	AA00820	8/9/00	0
		AA01690	8/23/00	1
		AA01840	9/6/00	3

D. Field Measurements and General Chemistry (Tables 3 and 4)

All field measurements and general chemistry values were within the normal ranges

TABLE 3
General Chemistry Results (mg/l) for Trail Creek and Its Tributaries
August 23, 2000

Site	Alkalinity	Hardness	NH ₃	NO ₃ .NO ₂	TKN	TP	TOC	TS	TSS	TDS	Cl ⁻	SO ₄	C-BOD LR
LMG070-0012	167	243	< 0.1	2	0.4	0.05	3	375	4	368	50	45	4.7
LMG070-0014	111	210	< 0.1	9.2	0.8	0.37	5.7	553	< 4	536	130	75	5.9
LMG070-0016	223	306	< 0.1	0.3	0.3	0.04	2.5	392	6	376	37	46	3.8
LMG070-0018	221	297	< 0.1	0.3	0.3	0.04	2.2	375	4	364	30	49	3.9
LMG070-0020	211	293	< 0.1	0.3	0.4	0.05	2.9	388	5	380	35	59	4.4

TABLE 4
Field Measurements for Trail Creek and Its Tributaries
August-September 2000

Site	Sample Date	DO mg/l	pH	WaterTemp °C	Conductance mS/cm	Turbidity NTU	Chloride mg/l	Chlorophyll mg/L	DO Saturation %
LMG070-0012	8/09/00	7.73	7.96	23.57	708	13	79.3	20.2	
	8/16/00	7.88	8.13	23.44	489	10.1	40.28	2	93
	8/23/00	8.62	8.14	22.23	713	4.1	78.34	6.2	99.5
	8/30/00	8.07	8.14	23.27	802	13.1	112.4	3.1	94.8
	9/06/00	10.17	8.1	18.1	593	8.6	211.2	2.5	107.6
LMG070-0013	8/09/00	8.1	7.9	23.15	735	23.1	86.9	3.4	
	8/16/00	8.74	8.06	21.72	803	7.6	92.2	2.9	99.7
	8/23/00	8.63	8.05	21.86	825	8.6	101.4	2.8	98.8
	8/30/00	7.92	8.07	22.87	810	10.9	105	3.5	92.3
	9/06/00	11.11	8.14	18.62	702	7.2	217.8	2.7	119.1
LMG070-0014	8/09/00	10.5	7.79	23.45	910	1.3	163	2.5	125
	8/16/00	12.1	7.92	22.6	962	2.6	164.1	3	140.8
	8/23/00	8.98	7.87	23.2	1043	0.8	180.3	2.8	105.3
	8/30/00	9.49	7.82	23.25	922	1	171.1	2.4	111.4
	9/06/00	13.27	7.83	21.74	855	0.5	258.8	3.1	151.8

LMG070-0015	8/09/00	7.94	8.03	21.3	714	21.3	64.01	5.4	89.7
	8/16/00	8.04	8.12	20.38	731	9.5	60.05	3.6	89.6
	8/23/00	8.2	8.13	20.03	752	10	70	2.9	90.7
	8/30/00	7.78	8.18	20.75	744	10.1	76.91	3.2	87.1
	9/06/00	11.75	8.24	14.9	652	6.8	230	4.3	11.68
LMG070-0016	8/09/00	8.24	7.92	21.38	710	13.2	60.03	4.3	94.5
	8/16/00	8.53	8.1	20.31	716	9.5	55.18	3.3	94.6
	8/23/00	8.46	8.1	20.23	739	8	64.11	3	93.9
	8/30/00	8.11	8.14	20.61	725	7.6	61.58	3	90.5
	9/06/00	12.23	8.23	15.1	642	5.6	246.8	3.3	121.8
LMG070-0017	8/09/00	8.45	8.11	21.66	685	9.3	50.2	3.2	96.6
	8/16/00	8.53	8.26	20.23	691	9.1	46.57	4	94.5
	8/23/00	8.47	8.21	20.36	708	5.8	52.9	3.1	94.2
	8/30/00	8.21	8.24	20.77	698	6.7	49.46	2.8	91.9
	9/06/00	12.54	8.31	14.9	605	6.8	207.6	2.6	124
LMG070-0018	8/09/00	8.36	8.1	21.51	680	8.4	48.93	3.3	95.1
	8/16/00	8.57	8.22	19.67	685	5.4	44.24	3.2	93.8
	8/23/00	8.35	8.18	19.78	707	5.2	48.77	3.6	92
	8/30/00	8.3	8.21	20.5	709	6.3	58.76	2.3	92.3
	9/06/00	12.42	8.28	15.07	612	5.3	190.7	3.5	123.4
LMG070-0019	8/09/00	8.68	8.07	20	705	25.5	58.03	3.2	97.7
	8/16/00	9.05	8.13	18.39	713	10.8	43.47	2.5	96.7
	8/23/00	8.41	8.12	18.82	734	7.4	47.62	3.4	91
	8/30/00	8.42	8.17	19.05	721	6.8	53.51	2.7	91.1
	9/06/00	12.52	8.24	13.79	619	5.2	197	3.4	120.7
LMG070-0020	8/09/00	8.32	8.06	21.2	717	8.4	49.35	3.7	96.5
	8/16/00	8.72	8.21	19.13	714	9.3	52.5	3.3	94.5
	8/23/00	8.36	8.16	19.52	721	5.4	52.84	3	91.7
	8/30/00	8.34	8.21	20.76	717	5.5	58.52	3.3	93.4
	9/06/00	12.56	8.32	14.56	631	5.6	186.7	3.4	123.7

Streamflow was as follows:

Table 5
Stream Flow in Trail Creek
USGS Gage at Franklin Street
Site LMG070-0012
August –September, 2000

Sampling Date	Stream Flow cfs
8/09/00	109
8/16/00	93
8/23/00	103
8/30/00	125
9/06/00	101

DISSCUSSION

The *E. coli* impairment in Trail Creek appears to be an issue of non point sources. The field notes indicated recent rains just before the August 9 sampling event, however *E. coli* levels in the watershed do not show that the rainfall resulted in appreciably higher bacteria levels. The Michigan City Sanitary District has a retention basin to collect stormwater combined sewer effluent to prevent discharges to Trail Creek. The average flow in Trail Creek during the sampling period was 99.25 cfs. Streamflow data taken from the USGS publication “ Water Resources Data Indiana Water Year 2000” indicated that the highest flow level in the creek during the sampling period was recorded at 140 cfs on 08/7/00. The lowest flow level during the sampling period was recorded at 64 cfs on 08/10/00.

RECOMMENDATIONS

Trail Creek will need to have a TMDL developed for *E. coli*. Evaluation of the *E. coli* Task Force sampling results from the other tributaries of Trail Creek will aid in the identification of sources of *E. coli*. The LaPorte County Health Department should be able to provide information on unsewered areas, which may have septic system discharges to the creek resulting in the relatively constant levels of *E. coli*. Based on the data generated from the fixed stations on Trail Creek and this sampling, Trail Creek can be delisted for cyanide.

E. coli Concentrations in Trail Creek August-September 2000

